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Title of the Invention: Electron emission device

Applicant: Matsushita Electric Industrial Co., Ltd.

Brief Description of Drawings:

FIG. 1 shows a top view illustrating an electron emission device according to an embodiment of the present invention, FIG. 2 shows a sectional view taken along a line A-A' shown in FIG. 1, and FIG. 3 shows a magnified view illustrating major parts for explaining the operation.

Detailed Explanation of the Invention:

The present invention relates to an electron emission device based on a new principle which utilizes the tunnel effect and the secondary electron emission without using the thermionic emission phenomenon.

An explanation will be made below about the structure and the operation principle thereof.

In FIGS. 1 and 2, reference numeral 1 indicates a glass substrate, and reference numeral 2 indicates a secondary electron emissive substance such as tin oxide (SnO_2) which is formed on the substrate 1 and which is composed of electrode lead sections 2a, 2b disposed at both ends and band-shaped sections 2c provided therebetween with narrow spacing distances intervening therebetween.

When the electrode lead sections 2a, 2b are connected to a DC power source to apply a DC voltage with such polarity that the electrode lead section 2b is positive, a large electric field is formed at an end portion of a mutually opposing cross section of the band-shaped electron emissive substance 2c. The large electric field increases the probability of emission of electrons contained in the solid to the outside in accordance with the tunnel effect.

On the other hand, the electric field is directed in the direction along the mutually opposing electron emissive substances. Accordingly, as shown in FIG. 3, the electrons eT, which are emitted in accordance with the tunnel effect, are accelerated by the electric field, and the electrons eT impact the mutually opposing secondary electron emissive substance 2c. Therefore, the secondary electron multiplication is performed by the impacted secondary electron emissive substance, and multiplied secondary electrons are formed in the impacted substance. Some of the secondary electrons eS may be highly possibly emitted to the outside of the solid again depending on the scattering angle. The present invention intends to utilize the electrons emitted as described above by leading and guiding the electrons in the direction perpendicular to the substrate 1.

The electrons, which inflow from the end 2a or 2b of the electrode as described above, are moved through the band-shaped electron emissive substance 2c one after

another while accompanying the secondary electron multiplication action. Thus, the electrons, which are more multiplied as compared with the tunnel electrons based on the simple substance, are emitted.

If the mutually adjoining end surfaces of the mutually adjoining secondary electron emissive substances 2c are simple parallel flat plates, it is impossible to decrease the spacing distance therebetween so much in view of the machining accuracy. Therefore, if the applied voltage is not increased, then no large electric field is generated on the end surface, and the tunnel effect hardly occurs. However, in the present invention, projections, each of which has a small radius of curvature at the tip, are provided on one of the opposing surfaces of the secondary electron emissive substance. Accordingly, even when the applied voltage is not increased, then a high electric field is generated in a concentrated manner at the tip of the projection P, and the tunnel effect is easily caused. Consequently, it is possible to increase the number of emitted electrons.

As described above, according to the present invention, the electrons, which are obtained in accordance with the tunnel effect, are subjected to the secondary electron multiplication. Further, the projections, each of which has the small radius of curvature at the tip, are provided on one of the mutually opposing surfaces of each of the mutually adjoining secondary electron emissive

substances. Accordingly, the high electric field is generated in the concentrated manner at the tip, and the electron emission is easily caused in accordance with the tunnel phenomenon. Thus, it is possible to obtain the large emission current at a low applied voltage.

Claim:

1. An electron emission device comprising two secondary electron emissive substances which are connected to a DC power source and which constitute electrode lead sections, and at least one secondary electron emissive substance which is provided between said two secondary electron emissive substances, wherein a projection, which has a small radius of curvature at a tip, is provided on a side of a mutually opposing end surface of said secondary electron emissive substance to which a negative voltage is applied.

Reference document: Japanese Patent Publication No. 44-26125

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⑩特許公報

⑪特許出願公告
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⑤4電子放出装置

⑳特　　願　昭43－3401
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図面の簡単な説明

第1図は本発明の一実施例における電子放出装置の上面図、第2図はそのA－A'線に沿う断面図、第3図は動作を説明するための要部拡大図である。

発明の詳細な説明

本発明は電熱子放出現象を用いずトンネル効果と二次電子放出を利用した新原理の電子放出装置に関するものである。

以下、その構造、動作原理を説明する。

第1図、第2図において、1はガラス基板、2は基板1上に形成された酸化錫（SnO_2）等の二次電子放出物質で、両端の電極とり出し部2a、2bと、その間にせまい間隔をへだてて設けられた帯状部2cからなる。

いま、電極とり出し部2a，2bを直流電源に接続して2b側が正になる極性に直流電圧を印加すると、帯状の電子放出物質2cの相対向する断面の端点に大きな電界が形成され、この大きな電界により、固体中の電子がトンネル効果により外部へ放出される確率が高くなる。

一方この電界は相対向する電子放出物質の方を向いているので第3図に示すようにトンネル効果により放出された電子e_Tはこの電界により加速され相対向する二次電子放出物質2cを衝撃する。したがつて衝撃された二次電子放出物質によつて二次電子増倍が行われ、衝撃された物質内に増倍二次電子をつくる。この2次電子e_Sのうちには、散乱角度によつては再度固体外へ放出される場合

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が充分起り得るわけである。本発明はこのようにして放出された電子を基板1と垂直な方向に引き出して利用しようとするものである。

このようにして電極一端2aあるいは2bから流入した電子が二次電子増倍作用を伴つて次々と帯状の電子放出物質2cを移動し、単体のトンネル電子よりも増倍された電子が放出されることになる。

ところで相となり合う二次電子放出物質2cの相となり合う端面が単なる平行平板では工作精度の関係でその間隔をあまり小さくできないので、印加電圧を大きくしないと端面に大きな電界が生じずトンネル効果が起りにくいが、本発明では二次電子放出物質の一方の対向面に先端の曲率半径の小さい突部を設けたため印加電圧を大きくしなくても突部Pの先端には集中的に高い電界が生じトンネル効果が起りやすく結局放出される電子の数を増加させることが可能になる。

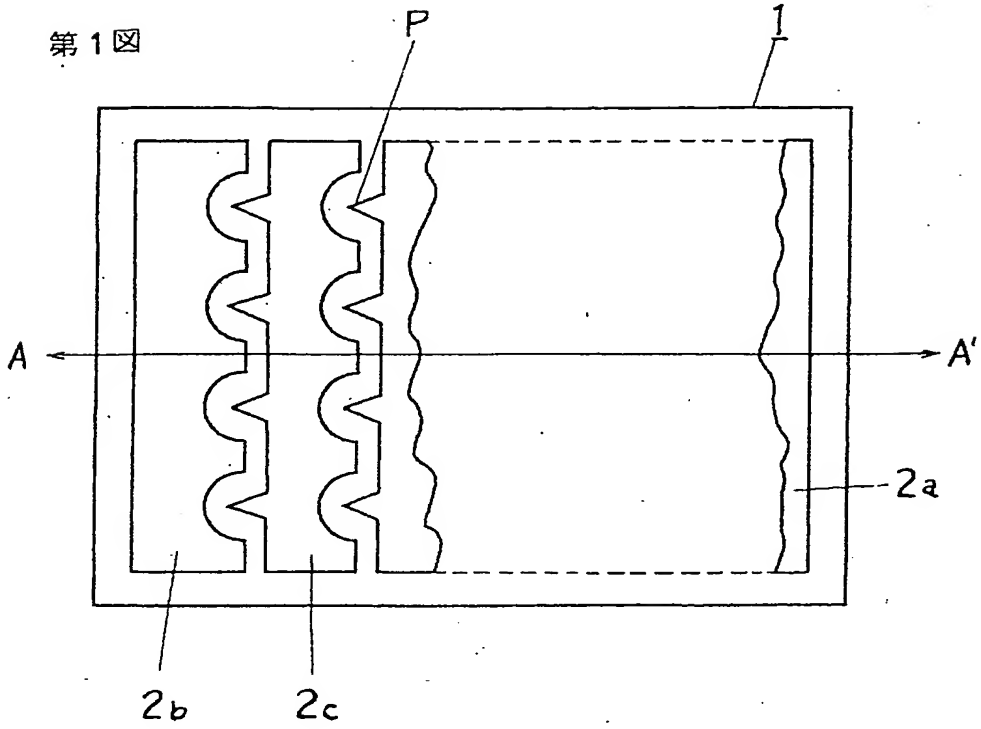
以上のように本発明によればトンネル効果によつてとり出した電子を二次電子増倍することによりさらに相となり合う二次電子放出物質の相向面の一方に先端の曲率半径の小さい突部を設けたためその先端に集中的に高い電界が生じトンネル現象による電子放出が起りやすくなり低い印加電圧で大きな放出電流を得ることができる。

特許請求の範囲

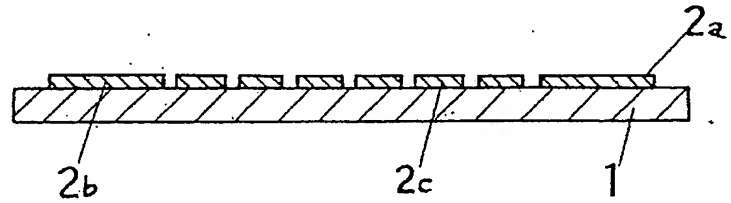
1　直流電源に接続され電極とり出し部を構成する2つの2次電子放出物質、上記2つの2次電子放出物質間に設けられた少くとも1つの2次電子放出物質を有し、上記2次電子放出物質の相対向する端面の負電圧が印加されている側に先端の曲率半径の小さい突部を設けたことを特徴とする電子放出装置。

引用文献
特　公　昭44－26125

第1図



第2図



第3図